Patent claims

1. Illumination system for wavelengths ≤ 193 nm, particularly for EUV lithography, with

1.1 a light source (1)

1.2 an object plane (14)

1.3 an exit pupil (24)

1.4 a first optical element with raster elements (5), which is illuminated by the light source (1) and which divides the light beam impinging from light source (1) into light channels

1.5 a second optical element with raster elements (9), wherein each light channel which is formed by the raster element (5) of the first optical element is assigned to a raster element (9) of the second element,

wherein

1.6 the raster elements (5, 9) of the first optical element and of the second optical element are each assigned to light channels, and the raster elements (6, 9) are configured or arranged such that a continuous beam path from light source (1) to object plane (14) results for each light channel, characterized in that

1.7 the assignment can be manipulated such that, by assigning the raster elements of the first to the second optical elements, a predetermined illumination is adjusted in the exit pupil of the illumination system.

2. Illumination system according to claim 1, further characterized in that the second optical element comprises such a number of pupil raster elements that at least two predetermined illuminations can be adjusted by changing the assignment of the raster elements of the first optical element to the raster elements of the second optical element, without having to replace the second optical element.

3. Illumination system according to claim 2, further characterized in that

the first optical element with raster elements can be exchanged and by replacing the first optical element it is possible to achieve a different assignment of the raster elements of the first optical element to the raster elements of the second optical element and thereby a different illumination in the exit pupil.

4. Illumination system according to claim 3, further characterized in that

the illumination system comprises a shifting device with a shifting table, on which a plurality of first optical elements is arranged, so that the first optical elements can be replaced by displacement of the shifting table.

5. Illumination system according to one of claims 1-4, further characterized in that

the number M of raster elements (9) of the second optical element is greater than the number N of raster elements (5) of the first optical element.

6. Illumination system according to claim 2, further characterized in that

the raster elements (5, 9) of the first optical element are mirror facets, which are arranged on a plate (7), and the light channel between the raster elements of the first and second optical elements can be adjusted by tilting the mirror facets of the first optical element relative to the plane of the plate, so as to realize different assignments of the raster elements of the first optical element with the raster elements of the second optical element and, thereby, different illuminations of the exit pupil.

7. Illumination system according to claim 1, further characterized in that

the second optical element with raster elements can be exchanged and at least one particular illumination in the exit pupil can be achieved with each second optical element, so that by replacing the second optical element, a different assignment of the raster elements of a first optical element with the raster elements of the second optical element is realized.

8. Illumination system according to claim 7,
further characterized in that
the first optical element with raster elements is interchangeable.

9. Illumination system according to claim 7,
further characterized in that
the raster elements of the first optical element are mirror facets and the tilt of the mirror facets of the first optical element can be changed.

10. Illumination system according to claim 1,
further characterized in that
the raster elements of the second optical element are mirror facets and the mirror facets can be shifted and tilted in order to realize a different assignment of the raster elements of a first optical element to the raster elements of the second optical element by shifting and tilting the mirror facets.

11. Illumination system according to claim 10,
further characterized in that
the first optical element with raster elements is interchangeable.

12. Illumination system according to claim 10,
further characterized in that the raster elements of the first optical element are mirror facets and that the tilt of the mirror facets of the first optical element can be changed.

13. Illumination system according to one of claims 1 to 12,
further characterized in that the raster elements of the first optical element are imaged in the object plane and the light channels are superimposed on each other in the object plane (14).

14. Illumination system according to one of claims 1 to 13,

further characterized in that

the raster elements (5) of the first optical element produce secondary light sources in or near the raster elements of the second optical element.

15. Illumination system according to one of claims 1 to 14, further characterized in that

the illumination system comprises a collector unit in front of the first mirror with raster elements.

16. Illumination system according to one of claims 1 to 15,

further characterized in that

the system contains at least one mirror or one lens (12), arranged in the light path after the second optical element with raster elements, wherein the at-least one mirror or lens images a plane, which is situated in or near the second optical element, in the exit pupil.

17. Illumination system according to one of claims 1 to 16,

further characterized in that

the raster elements of the second optical element and at least one mirror or one lens, which is arranged after the second optical element with raster elements, images the first raster elements in the object plane.

18. Illumination system according to one of claims 1 to 17, further characterized in that

the light channels between the first optical element with raster elements and the second optical element with raster elements are configured such that the illumination in the exit pupil is circular.

19. Illumination system according to one of claims 1 to 17, further characterized in that

the light channels between the first optical element with raster elements and the second optical element with raster elements are configured such that the illumination in the exit pupil is ring-shaped.

20. Illumination system according to one of claims 1 to 17, further characterized in that

the light channels between the first optical element with raster elements and the second optical element with raster elements are configured such that a number of segments that are separated from each other are illuminated in the exit pupil.

21. Illumination system according to claim 20,

further characterized in that

the number of segments is an even number of segments, in particular, two or four segments.

22. Method for adjusting a distribution of illumination in the exit pupil of an illumination system for wavelengths $\leq$ 193 nm, in particular for EUV lithography with an illumination system according to one of claims 1 to 21, further characterized in that

a given light distribution in the exit pupil is adjusted by replacing the first and/or second element with raster elements and/or by changing the prismatic effect and the arrangement of the raster elements of the first and/or second optical element, especially by tilting and/or shifting the raster elements of the first and/or second optical element, wherein the light channels between the raster elements of the first and second optical element are adjusted according to the pregiven illumination in the exit pupil.

23. EUV projection exposure system for microlithography with

- a source for generating EUV radiation

- an illumination system according to one of claims 1-21 with an exit pupil, which partially collects the radiation produced by the source and conducts it on to illuminate a ring field
- a pattern-carrying mask on a carrier system, wherein this mask lies in the plane of the ring field
- a projection device, especially a projection objective with an entrance pupil, which coincides with the exit pupil of the illumination system, wherein this projection objective images the illuminated portion of the pattern-carrying mask in an image field
- a light-sensitive substrate on a carrier system, wherein this light-sensitive substrate lies in the plane of the image field of the projection device.

24. EUV projection exposure system according to claim 23, further characterized in that

the projection exposure system is a scanning system, wherein the carrier system for the pattern-carrying mask can move in a first direction in the plane of the ring field.

25. EUV projection exposure system according to claim 24, further characterized in that

the projection exposure system contains one or more other carrier systems to accommodate several first and/or second optical elements, which can move in a second direction, and that the first direction is perpendicular to the second direction.

26. Method for making microelectronic components, especially semiconductor chips with an EUV projection exposure system according to one of claims 24-25.